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Satellite tracking of Kori Bustards *Ardeotis kori* in Kenya

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The Kori Bustard *Ardeotis kori* is a bird of open grasslands and lightly wooded savannah (Urban *et al.* 1986). It is endemic to Africa and occurs as two distinct populations, the race *kori* in southern Africa and the race *struthiunculus*, ranging from northwest Somalia and southeast Sudan through Kenya to north and central Tanzania (Johnsgard 1991).

Though the species is still widespread (Zimmerman *et al.* 1996), its population is thought to be declining and becoming fragmented (Johnsgard 1991). The southern African race is already considered Vulnerable in the South African Red Data Book (Brooke 1984). Threats include destruction of grasslands, illegal hunting and poisoning. The species is also susceptible to collision with overhead power lines, and to being killed while crossing roads (del Hoyo *et al.* 1996, Johnsgard 1991).

The birds normally occur alone or in pairs, but occasionally flock to exploit clustered food resources. For example, they are known to gather on stubble fields in parts of Narok District following the wheat harvest (Bennun & Njoroge 1997), and they form loose aggregations after the rains (Mwangi & Karanja 1989). They are suspected to make wide-ranging movements in East Africa (Urban *et al.* 1986, Mwangi & Karanja 1989), though there is little direct evidence for this.

This note describes a preliminary study of Kori Bustard movements in Kenya using satellite tracking. Our study was intended to test the feasibility of this method of tracking large bustards in East Africa. Satellite tracking has many advantages over other methods of monitoring movements, not least in that data can be collected regularly and remotely (Bennun & Njoroge 1997). If proved successful, the technology—including capture and harnessing techniques—could be used for research on more severely threatened bird species, such as Lesser Flamingos *Phoeniconaias minor* and Denham's Bustard *Neotis denhamii*.

Methods

Two Kori Bustards (one adult male weighing 12 kg and one immature weighing 7.5 kg) were caught at Game Ranching Ltd, an 8100-ha privately-owned game ranch situated on the Athi-Kapiti plains, 40 km southeast of Nairobi, on 15 and 16 June 1996. The gently rolling terrain is mainly open grassland with scattered *Balanites glabra* and *Acacia drepanolobium* trees.

After careful examination of the options, we decided to dazzle the bustards at night using a powerful spotlight (1 million candle power). This proved a safe and effective method. During two moonless nights, bustards were located and approached across the open grassy plains in a four-wheel-drive vehicle. At close range, the birds were dazzled, run down and trapped in a large, long-handled hoop net (1-m diameter; handle length 3 m; 1.5-cm gauge fishing net). After capture the bustards were gently restrained by two people, and a hood placed over their heads to calm them. They were checked for parasites and injuries, and blood samples were taken (for further analysis in the laboratory). Satellite-transmitters (PTT) were then attached as a back-pack using Teflon tapes (Bally Ribbon Mills, USA) and following a modified Brander (1968) technique. The PTT had three attachment points (two at the back and one at the front). The back loop and the neck loop were connected together on the belly of the birds by a breast loop. For attachment we used small metal buckles, which allowed for adjust-

ment of the length of the breast loop to the size of the bird. This design also allowed for fine adjustment of the PTT on the back of the bird.

Two types of transmitters were used. One, weighing 90 g (Mariner Inc., Reg. No. 7753), fitted on the adult bird, had a duty cycle of 6 h on and 6 h off; the second, weighing 35 g, (Microwave Inc. Reg. No. 26705), fitted on the immature bird, had a duty cycle of 8 h on and 24 h off for seven days and then 8 h on and 96 h off for the rest of its lifespan. The latter transmitter was also provided with a temperature sensor, allowing measurement of the ambient temperature of the bird's location, after correction, as described by Osborne *et al.* (1997a). The bustards were released within 45 min of capture.

Tracking data were collected through the Argos system (Tillade 1992) and their quality categorized in several classes (3, 2, 1, 0, A, B and Z, in order of best to worst quality). These classes are based on satellite-transmitter geometry during a pass of the satellite, the number of signals during the pass and transmitter frequency stability. In addition, for a location to be made available it must test positive for at least two of four plausibility tests. The estimated theoretical accuracy for each class are: Class 3 = better than 150 m; Class 2 = better than 350 m; Class 1 = better than 1000 m; Class 0 = over 1000 m. The Argos system does not provide an accuracy estimate for classes A, B and Z (they are locations without guarantee), but, by looking at the quality parameters, one can determine which class A locations are of good quality and infer an accuracy equivalent to that of class 0 and above. Classes 0, 1, 2 and 3 have 95% of the locations within 3 km (Tillade 1992). For our analysis we only used data of quality A and better. From the data obtained we analysed movements, area used and distances travelled.

Results and discussion

The transmitter on the adult bird malfunctioned after a few sporadic locations, which were not analysable. The transmitter on the immature bird provided data for a period of 7 months, during which 94 locations were obtained. Of these, 68% were of class A or better. Ambient temperatures provided by this transmitter ranged from 13.4° to 46.6°C, with an average of 26.4°C. The minimum total distance travelled by the immature bird (the sum of all interlocation distances) was 607.4 km over a period of 215 days. On average, the bird travelled 9.6 km (minimum 1.1 km, maximum 39.3 km) between successive locations, but covered a mean distance of 1.5 km d^{-1} (S.D. 2.33). It ranged over an area of 875 km^2, based on the 95% harmonic mean method of estimating home range size (White & Garrott 1990). Apart from two large movements to the east and west of the capture site, the bird stayed within *c.* 10 km of the capture site for most of the study period. All locations made between June and December 1996 are summarized in Fig. 1.

Our results, albeit incomplete, show that large bustards can be tracked using satellite transmitters. The many small-amplitude movements and short interlocation distances suggest that the immature bird was resident in the area, and was exploiting a series of habitat patches (Osborne *et al.* 1997b, Combreau & Smith 1996, del Hoyo *et*

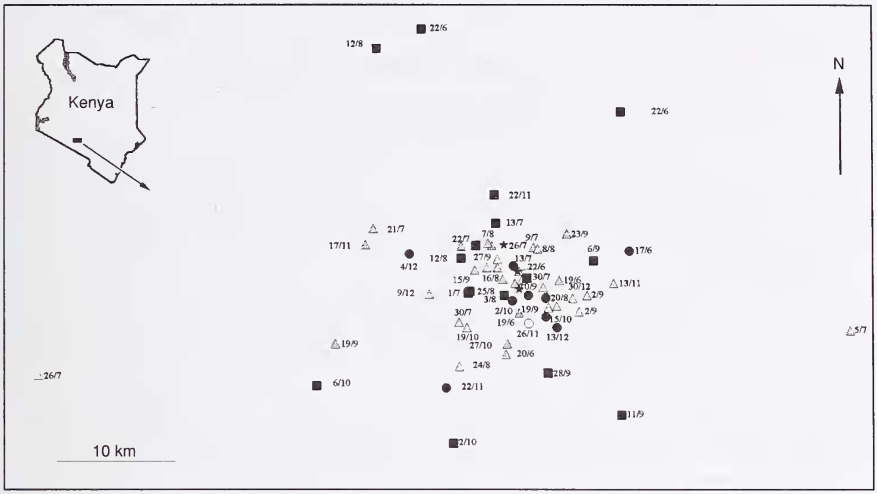

Figure 1. Movements of an immature Kori Bustard (PTT Reg. No. 26705) tracked by satellite and the quality of relocation points between 6 June and 13 December 1996 in central Kenya. Location quality code symbols: grey triangle = 0, solid circle = 1, star = 2, open circle = 3, solid square = A. The solid rectangle in the small map of Kenya represents the area of the main map

al. 1996). The two much longer interlocation distances could represent exploratory movements: these are typical of immature birds (Maclean 1990), and have also been recorded in the Houbara Bustard *Chlamydotis undulata* (Combreau & Smith 1996). Further investigation is necessary to determine the causal factors that lead to these movements.

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